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far from being of opinion that nothing further remains to be done. "For example," says he, "no one of my acquaintance has connected in an entirely satisfactory manner, and even to their numerical values, the planetary disks which the stars acquire, and the rings which surround them, with the theory of interferences." He adds, that he had been informed that M. Schwerd, a geometer of Germany, had succeeded in this research; but he was told at the same time that, according to the calculations of M. Schwerd, which besides were applied exclusively to simple lenses not achromatic, the diameters of the planets when seen in a telescope with a reduced aperture ought to appear enlarged like the stars, a result entirely contradicted by observation.*

Exposé historique des Travaux exécutés jusqu'à la fin de l'année 1851, *pour la Mesure de l'Arc du Méridien entre Fuglenæs,* 70° 40′, *et Ismäil,* 45° 20′. *Publié au Nom de l'Académie Impériale des Sciences de St. Pétersbourg, par W. Struve, Directeur de l'Observatoire Central de Russie. Suivi de Deux Rapports de M. G. Lindhagen, Astronome de l'Observatoire central sur l'Expédition de Finmarken, faites par Ordre du Gouvernement Norvégien en* 1850; *et sur les Opérations de Lapponie, exécutées en* 1851, *sous les Auspices de l'Académie Royale des Sciences de Stockholm.* 4to. pp. 44. St. Pétersbourg, 1852.

In this Report M. Struve gives a brief history of the operations connected with the measurement of the Russo-Scandinavian arc of the Meridian, which has now attained the colossal extent of 25° 20′. This great undertaking was first commenced in Russia in the year 1816, and was finally brought to a close in 1851, the labours of its execution having, consequently, embraced a period of thirty-seven years.

As has happened in some other similar instances, the measurement of this arc was not an independent project undertaken with a view to the advancement of physical science, but was suggested by the operations connected with the trigonometrical survey of a portion of the Russian empire. In 1816, M. Struve and General Tenner were charged, the one with the trigonometrical survey of Livonia and the other with that of Lithuania; and it occurred to both geometers to profit by their labours in measuring an arc of the meridian in their respective provinces.

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* In the *Cambridge Philosophical Transactions*, vol. v. p. 283 *et seq.*, Mr. Airy, proceeding upon the principles of the undulatory theory of light, has investigated the diffraction produced by an object-glass having a reduced aperture of a circular form, and has calculated the numerical values of the diameters of the spurious disks of the stars and of the alternate dark and bright rings surrounding them. The results were found to present a satisfactory agreement with Fraunhofer's measures.—EDITOR.

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It has been established by numerous experiments made with the pendulum in different parts of the world, that the parallels on the surface of the earth are nearly circles; or in other words, that the earth, supposing its surface reduced to the level of the ocean, may be regarded as a solid of revolution. From this circumstance it follows, that we may investigate the dimensions and figure of the earth by combining together the partial arcs measured under different longitudes. The solution of the problem would not, therefore, present any serious difficulty, were it not that, independently of the unavoidable small errors of observation, there exists a disturbing influence, which generally affects the comparison of two arcs of the meridian measured under very different latitudes. This consists in a deviation of the plumb-line, occasioned either by the inequalities of the surface of the earth *above* the level of the ocean, or by irregularities in the densities of the strata *beneath* the same level, which tends in a greater or less degree to vitiate the result of every measure of an arc of the meridian. According to the researches of the illustrious Bessel, the probable error of a determination of latitude due to this cause amounts to 1″·8. Hence it is manifest, that the accuracy of the final results in any case will be enhanced by selecting for the field of operations a region subject as little as possible to local disturbance, and by giving a considerable extension to the arc measured.

The region through which the Russian arc extends appears to offer peculiar advantages for geodesical operations, in so far as the effects due to inequalities on the surface of the earth are concerned. Throughout the whole of this region, extending from the Danube to Lapland, and comprising an arc of the meridian of 20°, there does not exist a single mountainous mass tending to produce a sensible deviation of the plumb-line. In the southern portion, indeed, between the Dniester and the Dwina, the surface is so level and so wooded that it was frequently necessary to have recourse to artificial stations, in order to obtain a clear view of the surrounding region.

M. Struve having completed the survey of Livonia in the year 1819, suggested to the University of Dorpat the desirableness of profiting by the stations of the survey, to measure the arc of the meridian of 3° 35′, comprised between the island of Hogland in the Gulf of Finland, and the town of Jacobstadt in Courland,—an arc passing very nearly through the meridian of the observatory of Dorpat. Through the favourable representations of that body, the sanction of the Emperor was obtained for the execution of the project, and the operations connected with it were finally completed in the year 1827. In the same year General Tenner completed the measurement of an arc of 4° 32′, between Bristen in Courland, and Belin in the province of Grodno, by taking advantage of the principal triangles of his operations situate in the prolongation of the Observatory of Wilna.

Bristen, the northern point of the Lithuanian arc, being situate only 4′ 47″ to the south of Jacobstadt, the extreme southern station

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of the arc of Livonia, it obviously became desirable to unite the two partial arcs together into one complete arc. This was effected, independently, by M. Struve and General Tenner, in the years 1827–28. The results of the two geometers, accompanied by sealed letters, were submitted to the examination of the illustrious Bessel, who found them to present a most satisfactory accordance; and they were finally published in the year 1832. Thus was completed the first period in the history of the Russian arc, which at this stage of its progress extended from Hogland to Belin, and embraced an amplitude of 8° 2′·5.

The Russian Arc of the Meridian thus measured by M. Struve and General Tenner was, with two exceptions, the most extensive hitherto determined, ranking immediately after the great arc of India and the French arc. It constituted one of the ten arcs of the meridian which Bessel employed in his famous investigation of the dimensions and figure of the earth.

M. Struve did not fail soon to perceive the desirableness of extending the arc northwards, so as to form a junction with the Swedish arc measured in Lapland. Two circumstances suggested the importance of executing this operation. In the first place, it appeared that the northern arcs were not represented in sufficient fulness in Bessel's researches, although the coefficient of the ellipticity mainly depends on a comparison of such data with the arcs near the equator. Secondly, there existed some doubts respecting the Lapland arc, which tended to impair its trustworthiness as one of the elements for determining the earth's figure. This arc, as is well known, was originally measured by the French Academicians and Celsius in the year 1735; but, upon being re-measured and somewhat extended in the beginning of the present century, under the auspices of the Academy of Sciences of Stockholm, it was found that the results of the two operations assigned considerably different lengths to a degree of the meridian under the polar circle.

In 1830, M. Struve obtained the consent of the Emperor for the prolongation of the Russian arc through Finland to Tornea, the southern extremity of the Lapland arc. This undertaking was forthwith commenced, and was ultimately completed in the year 1845, M. Struve having for his principal coadjutor M. Wolstedt, now Director of the Observatory of Helsingfors, who continued during ten years to execute all the astronomical observations and all the operations connected with the measurement of the terrestrial angles, although physical obstacles of the most formidable nature constantly opposed his efforts. The length of the arc measured on this occasion was 5° 26′.

During the execution of this operation, General Tenner, by prosecuting his geodesical operations, was enabled to prolong the arc southwards to the river Dniester, which forms the northern frontier of the province of Bessarabia. This gave a further addition of 3° 18′ to the Russian arc, which now extended from Tornea, lat. 65° 50′ 34″, to Souprounkovtsi, lat. 48° 45′ 1″, and attained an amplitude of 17° 5′ 33″. In 1847, M. Struve communicated a note to the Aca-

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demy of Sciences of St. Petersburg, containing the provisional results deducible from this arc, in which he announced that they seemed to indicate an enlargement of the value assigned by Bessel to the terrestrial ellipticity, viz. $\frac{1}{299 \cdot 15}$.

While the extension of the Russian arc in both directions, to which allusion has just been made, was in the course of being executed, the Imperial Government gave its sanction that the operations should be prolonged southwards as far as the River Danube, through the entire province of Bessarabia, by which an additional length of 3° 25′ would be given to the arc. This project was carried into complete effect in the year 1849, when the Russian arc finally attained a length of 20° 31′, extending from Tornea in Lapland, to Ismäil on the Danube.

The standard of linear dimensions employed in the measurement of the Russian arc had been compared with the toise of Peru by M. Arago, in the year 1821. As it was desirable that a similar comparison should be instituted between it and the standard employed in the measurement of the great arc of India, M. Struve proceeded to England in 1847, with a view to the promotion of this object. Of the two standards employed in this operation, one which Colonel Everest had brought from India was, with the sanction of the East India Company, transported to Russia, and compared directly with the standard of Pulkowa.*

In 1844, M. Struve was appointed by the Academy of Sciences of St. Petersburg to proceed to Stockholm, with the view of suggesting to the Swedish Government the expediency of prolonging the Russian arc to the Northern Ocean. This mission was attended with complete success. The measurement of the Norwegian portion of the arc was assigned to M. Hansteen of Christiania, and that of the Swedish portion to M. Selander, Director of the Observatory of Stockholm. The actual execution of the operations connected with the Norwegian arc is due to M. Klouman and M. Lindhagen, the latter of whom was detached from the Observatory of Pulkowa to assist in the undertaking. The measurement of the entire Scandinavian arc was finally completed in 1851. The Swedish arc extends from Tornea, lat. 65° 51′, to Atjick, lat. 68° 54′, and has an amplitude of 3° 3′; the Norwegian arc extends from Atjick to Fuglenaes, lat. 70° 40′, and has an amplitude of 1° 46′. The two arcs combined together have, therefore, an amplitude of 4° 49′. "It is thus," says M. Struve, "that the operations of the Scandinavian arc, commenced in 1846, have been completed in 1851. During these six consecutive years, M. Selander, associated with several assistants, has annually undergone the fatigues and perils attending a geodesical and astronomical operation, to be executed in an almost desert country, and situate between 66° and 69° of latitude. We sincerely congratulate M. Selander on the

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* The Indian standard was brought back to this country in the year 1850 by M. Otto Struve, and was deposited in the hands of the Astronomer Royal, agreeably to the engagement entered into with the East India Company.

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accomplishment of his arduous task; and certainly the learned world will agree with us in awarding to him the acknowledgments which are due to the execution of a scientific work of no less importance than difficulty."

The Russian and the Scandinavian arcs of the meridian now form one continuous arc,—appropriately termed by M. Struve the Russo-Scandinavian arc,—extending from Ismäil on the Danube, lat. 45° 20′, to Fuglenäes on the Northern Ocean, lat. 70° 40′, and possessing an amplitude of 25° 20′. The scientific world cannot fail to look forward with much interest to the results relative to the ellipticity of the earth deducible from the data furnished by this colossal undertaking.

Anleitung zur Geographischen Ortsbestimmung vorzüglich Mittels des Spiegelsextanten, von Mag. J. G. F. Bohnenberger. Neu Bearbeitet von Dr. G. A. Jahn, mit fünf tafeln Abbildungen. Göttingen, 8vo. 1852.

In this new edition of a work, which has long enjoyed a well-merited popularity in Germany, several improvements are effected, which are calculated to adapt the work to the present advanced state of astronomical and geographical science. The portion in the original edition relating to the quadrant is entirely suppressed, and new subjects introduced in its stead; among which may be mentioned an explanation of the use of the patent reflecting circle of Pistor and Martins of Berlin, and of the portable transit instrument for the determination of latitudes by means of observations made in the prime vertical.

COMET (I.) 1853.

Observations of this comet, made in various places, will be found in No. 856 of the *Astronomische Nachrichten.*

COMET (II.) 1853.

The comet discovered by M. Schweizer on the 4th of April has been observed at Hamburgh by M. Rümker. It appeared tolerably distinct, with a nucleus and short tail. The following observation of it is given by M. Rümker, in No. 857 of the *Astronomische Nachrichten* :—

	Hamb. M.T.	Comet's R.A.	Decl.
1853.	h m s	° ′ ″	° ′ ″
April 16	13 43 48	306 55 48·9	+12 33 10·9

Apparent Place of Star of Comparison, *η Delphini.*

R.A.	Decl.
h m s	° ′ ″
20 26 59·48	+12 31 23·2

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COMET (II.) 1852.

Observations of this comet, made at the observatory of Berlin, and extending to Jan. 9, 1853, are given in the *Astronomische Nachrichten*, No. 856, p. 250.

PSYCHE.

An ephemeris of this planet for the opposition of 1853 has been calculated by Dr. Oudemans of Leyden (*Ast. Nach.* No. 858, p. 294). It extends from April 12 to May 12.

COMET OF ENCKE.

Observations of this comet, made at the observatory of Breslau in the year 1852, will be found in No. 858 of the *Astronomische Nachrichten*.

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